Application Development Innovation at Kaiser Permanente with the IBM Decision Management and Cognitive platform

David Herring, Process Transformation Manager, Kaiser Permanente
Laurent Clermont, Cloud Technical Specialist, IBM
Jeff Goodhue, Cloud Solution Architect, IBM
Your Presenters

Jeff Goodhue
- Cloud Solution Architect focusing on Business Process and Decision Management
- Enjoys leading dynamic interactions within solutions that enable business users to engage in the operational change management process.

Laurent Clermont
- 12 years of experience in Business Process & Decision Management.
- Assist companies to improve & optimize their operations by involving directly business teams in their design & change life-cycle.

David Herring
- Leads the Process Transformation and Decision Management Program at Kaiser Permanente
- Believes in developing innovative techniques that rapidly enhance healthcare applications without disrupting them
- Holds a Msc from Heriot-Watt University, Edinburgh in Digital Systems & AI
About Kaiser Permanente
Nation’s largest not-for-profit health plan

Scope includes ambulatory, inpatient, ACS, behavioral health, SNF, home health, hospice, pharmacy, imaging, laboratory, optical, dental, and insurance
Our Decision Management Journey

**SOA Infrastructure**
Enterprise Service Bus, Message Broker, WSRR, Web Services, APIs, ITCAM, DataPower, WAS

**Real Time In-Context Decision Management**
Operational Decision Automation, Tactical Decision Support, Rules using Location and Time Dimensions

**Predictive Analytics**
Predict Trends, Recognise Patterns, Manage Risk, Forecast Outcomes, Strategic Decisions Based on Evidence

**Business Process Management**
Task Orchestration, Message Notification, Document Generation, & WS integration

**Complex Event Processing**
Design and Develop a Robust Event-Centric Enterprise Capable of invoking Business Rules and integration with the IoT
What you will see today

• The demonstrations we will show today are prototypes and not production code.
• These prototypes were developed as part of a collaboration between IBM and KP over the past few months.
• We believe this type of technological exploration / trystorm is a great way to:
  • Illustrate what could be the value of combining a polyglot of technologies (Business Rules, Complex Events, Operational Messages, Cognitive Insight and Hybrid Cloud) to design & develop intelligent healthcare applications
  • Rapidly identify the scenarios and projects that could use the emerging technologies
  • Help our customers visualize emerging technologies in the context of relevant scenarios and existing assets
Kaiser Permanente have been assertively investing and adopting IBM technology for over a decade. Kaiser have mature and successful enterprise SOA and BPM programs. We are now adopting emerging technologies (IBM Watson, IoT and IBM Operational Decision Manager Rules & Insights) that enhance our capabilities without disrupting our Member, Clinical Staff and Insurance Professionals.

Prototype Demonstrations

1. Member Centric Notifications for Health Scenarios
2. Fight the Flu with Cognitive Operations
Trystorm Solution
Architecture

Medical Events
- Appointments
- ADT (Admission, Discharge, Transfer)
- Pharmacy Prescriptions
- Lab Results

Social Events
- Web Analytics and SoI (Systems of Intelligence)
- Twitter
- Weather
- News

Structured data

Unstructured data

Bluemix and NLP
- Language
- Sentiment
- Classification

ODM Decision
Server Insights
- Business Rules
- Events
- Time
- Geolocation

Complex Event Correlation

Actions
- Notifications
  - Gov
  - KP
  - Personalization
  - Members/Groups
- Business Process
  - BPM
  - Campaign Initiation
  - Survey / Feedback

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Member Centric Notifications for Health Scenarios

Deliver Member Centric Notifications to Relevant Members, combining Enterprise Data with Air Quality and Weather processed through IBM ODM
Notifications of Today

• General
  • not specific to me (segmentation/conditioning)
  • not providing valuable content

• Late - I could have used this...
  • last week,
  • yesterday, or
  • a few minutes ago

• Difficult to Change - requires technical expertise to...
  • change content
  • change segmentation/conditioning
• SOA Messaging and Integration to achieve...
  • assured delivery, SOR integration and more
  • *not the focus on this discussion*

• Decision Management to achieve business ownership of...
  • the conditions and and notifications content

• Cognitive APIs to access diverse information
  • from hybrid cloud sources,
  • with cognitive processing

• The solution will leverage IBM ODM Standard
Air Quality Health Notifications

Air Quality Index (AQI):
- an index the US EPA (Environmental Protection Agency) uses to report daily air quality.
- how clean or polluted the air is
- what associated health effects might be a concern, especially for ground-level ozone and particle pollution

<table>
<thead>
<tr>
<th>Air Quality Index (AQI) Values</th>
<th>Levels of Health Concern</th>
<th>Colors</th>
</tr>
</thead>
<tbody>
<tr>
<td>When the AQI is in this range:</td>
<td>air quality conditions are</td>
<td>as symbolized by this color:</td>
</tr>
<tr>
<td>0-50</td>
<td>Good</td>
<td>Green</td>
</tr>
<tr>
<td>51-100</td>
<td>Moderate</td>
<td>Yellow</td>
</tr>
<tr>
<td>101-150</td>
<td>Unhealthy for Sensitive Groups</td>
<td>Orange</td>
</tr>
<tr>
<td>151 to 200</td>
<td>Unhealthy</td>
<td>Red</td>
</tr>
<tr>
<td>201 to 300</td>
<td>Very Unhealthy</td>
<td>Purple</td>
</tr>
<tr>
<td>301 to 500</td>
<td>Hazardous</td>
<td>Maroon</td>
</tr>
</tbody>
</table>
Air Quality Historical and Real-Time Monitoring
Demonstration
Cognitive Flu Fighters!

Fight the Flu with Cognitive Operations! Epidemic Detection combining Social Media, & IBM Watson Micro Services correlated with Enterprise Data and IBM ODM
Executive Summary

• Flu Has Real Impact: $10.4B yearly direct medical expenses, additional $16.3B lost earnings
• Multiple prototypes complete
• New solution architecture designed
• Next Steps:
  • Iteratively design and build **Pilot**
  • Test **Pilot** on Southern Hemisphere Flu Season
  • Improve, design and build **Production** for Northern Hemisphere
• Impact:
  • Preventive Care
  • Reduce Healthcare Costs (Tentative)
  • Supply Chain
  • Economic Impact
Flu Has Real Impact:
“Each year, on average, 5 percent to 20 percent of the U.S. population gets the flu, tens of thousands are hospitalized and thousands die from flu-related illness. This costs an estimated $10.4 billion a year in direct medical expenses and an additional $16.3 billion in lost earnings annually. Employers can play an important role in preventing flu, helping to protect employees’ health and reducing losses in productivity and revenue.” Molinari NA, et al. Vaccine 25 (2007)

IBM ODM Impact on Preventive Care
• Epidemic Prediction (to validate comparing to CDC)
• Detect epidemic epicenter and severity
• Alert facilities/members with timely and relevant data
• Launch appropriate business process for epidemic management
  • Facility Operations (Staffing, Resources, etc.)
  • Secondary Infections/Diseases/ Complications
  • Immunizations/Education/ Outreach
• Research - Social Media Flu Batch Analysis:
  • Exists from many other organizations (CDC, Johns Hopkins and more)
  • Currently batch based (weekly, monthly, yearly) with late action

• KP + IBM Collaboration - Real-time Actionable Insights:
  • First Trystorms: Brainstorm and Build/Try sessions including DSI Ready Room, DSI Flu and DSR Air Quality prototypes
  • IBM Conferences: Insight and InterConnect presentations with prototypes
  • Current Trystorm: Extend DSI Flu prototype to include multi-channel analysis, adding business context from KP and new event/action capabilities
Enabling Platform Capabilities

- **Leverage Existing SOA** - foundational KP messaging infrastructure
- **Bluemix with NLP** (Natural Language Processing)
  - Translation
  - Sentiment Analysis
  - Natural Language Classification
- **Business Rules** - point-in-time decision making
- **CEP** (Complex Event Processing) - real-time actionable events
  - Rules
  - Events, Time and Geolocation
- **BPM** (Business Process Management) - orchestrated, immediate action

Descriptive, Predictive, Prescriptive
 KP Member Flu Stories

Wave #1
Members & weather start a trend.

Wave #2
News Agencies feel a trend.

Wave #3
Doc diagnosis confirm a trend.

Wave #4
Lab results certify a trend.

Wave #5
Gov Agencies announce a trend.

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Demonstration
Step 1 – Detecting a Critical Number of Admissions of Flu Patients
Level 3 Alerts

Based on a Critical Number of Admissions
Level 3 Alerts

Based on a Critical Number of Admissions

when an admission occurs
if
  the admission condition of this admission is one of \{ Flu , Food poisoning \}
then
  emit a new admission alert where
  the county is the county of 'the hospital',
  the admission condition is the admission condition of this admission ;

definitions

set 'RECENT ADMISSION ALERTS' to all admission alerts
  where the admission condition of each admission alert is Flu
  and each admission alert is during the last period of 15 hours ;
if
  the number of 'RECENT ADMISSION ALERTS' is at least 6
then
  for each hospital in the hospitals of 'the county' :
    - emit a new notification to hospital where
      the risk is Flu epidemic ,
      the notification level is 3 ,
      the hospital is this hospital ;
Step 2 – Making Sense of Tweets
**THE LIFE CYCLE OF THE FLU**

**THE FIRST 24 TO 48 HOURS**

**WHAT'S HAPPENING IN THE BODY:**
The flu virus somehow comes into contact with your respiratory tract, either through breathing it in as an aerosol from someone's cough or sneeze, or touching a contaminated surface and then putting your hands near your mouth, nose or eyes. The virus makes its way into the cells that line your respiratory tract and begin replicating.

**WHAT IT FEELS LIKE:**
No symptoms (so far!).

**THE NEXT FIVE TO SEVEN DAYS**

**WHAT'S HAPPENING IN THE BODY:**
Immune cells are recruited to the locations where the virus is replicating, and send out signaling molecules to alert the body to kick the immune response into gear. Your body mounts up an immune system response to attack the virus so that it can't infect new cells.

**WHAT IT FEELS LIKE:**
You experience a very sudden onset of fever, fatigue, sneezing, chills and muscle/body aches.

**THE LAST FEW DAYS**

**WHAT'S HAPPENING IN THE BODY:**
Thanks to your body's immune system, it's goodbye flu virus! Inflammation finally decreases.

**WHAT IT FEELS LIKE:**
You may still experience some lingering fatigue or sore throat (from the damage coughing does to your throat), but the fever and bulk of the symptoms are gone.

How would people typically tweet?

Cognitive Pre-Processing of the Tweets
### RELEVANT

<table>
<thead>
<tr>
<th>Tweet</th>
</tr>
</thead>
<tbody>
<tr>
<td>I feel dizzy</td>
</tr>
<tr>
<td>What a terrible headache</td>
</tr>
<tr>
<td>I am sick, maybe flu</td>
</tr>
<tr>
<td>the entire family is feeling flu symptoms</td>
</tr>
<tr>
<td>I hate these flu stomach aches I have.</td>
</tr>
<tr>
<td>Probably flu</td>
</tr>
<tr>
<td>Doctor told me I have a flu.</td>
</tr>
<tr>
<td>Not going to school</td>
</tr>
<tr>
<td>here i am suffering flu and sore throat</td>
</tr>
<tr>
<td>I'm pretty sure I'm getting the flu</td>
</tr>
<tr>
<td>Flu and fever in the house</td>
</tr>
<tr>
<td>Flu got me like i can't even breath</td>
</tr>
<tr>
<td>Sorry, I'm just getting over the flu</td>
</tr>
<tr>
<td>Wife has viral flu, son ear infection,</td>
</tr>
<tr>
<td>daughter a cold.</td>
</tr>
<tr>
<td>Joy!</td>
</tr>
<tr>
<td>I have the flu</td>
</tr>
<tr>
<td>I really have the flu again</td>
</tr>
<tr>
<td>i am dying with this flu</td>
</tr>
<tr>
<td>Fever is getting better. Now got a flu.</td>
</tr>
<tr>
<td>Stomach flu or food poisoning? Either way,</td>
</tr>
<tr>
<td>it's awful</td>
</tr>
<tr>
<td>9 days in bed with flu</td>
</tr>
<tr>
<td>seriously i have not felt this horrible</td>
</tr>
<tr>
<td>flu before</td>
</tr>
<tr>
<td>i missed a week of school because of that</td>
</tr>
</tbody>
</table>

### NOT RELEVANT

<table>
<thead>
<tr>
<th>Tweet</th>
</tr>
</thead>
<tbody>
<tr>
<td>CDC Says the Flu Shot is Less Effective</td>
</tr>
<tr>
<td>Doc said ER waiting room is most likely</td>
</tr>
<tr>
<td>place to catch a cold</td>
</tr>
<tr>
<td>We've made changes to our visitor policies</td>
</tr>
<tr>
<td>to protect our patients and staff from the</td>
</tr>
<tr>
<td>#flu</td>
</tr>
<tr>
<td>Erie County may have a mild or late flu</td>
</tr>
<tr>
<td>season</td>
</tr>
<tr>
<td>The flu vaccine takes up to 14 days to</td>
</tr>
<tr>
<td>start working</td>
</tr>
<tr>
<td>dogs can get the flu just like people</td>
</tr>
<tr>
<td>Flu season starting</td>
</tr>
<tr>
<td>In California flu seems big</td>
</tr>
<tr>
<td>Get Ready For Flu Season</td>
</tr>
<tr>
<td>Increase in flu cases this month in the</td>
</tr>
<tr>
<td>Bay Area</td>
</tr>
<tr>
<td>Latest flu vaccination uptake figures</td>
</tr>
<tr>
<td>released</td>
</tr>
<tr>
<td>Utah: Tens of flu cases</td>
</tr>
</tbody>
</table>

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[IBM Logo]

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Invoking the Flu Tweet Natural Language Classifier

- "classifier_id": "c7fa4ax22-nlc-7007"
  "text": "Defending PHD thesis on flu epidemiology"
  "class_name": "NOTRELEVANT"
  "confidence": 0.986

- "classifier_id": "c7fa4ax22-nlc-7007"
  "text": "I am shivering"
  "class_name": "RELEVANT"
  "confidence": 0.992

- "classifier_id": "c7fa4ax22-nlc-7007"
  "text": "Defending PHD thesis on flu epidemiology"
  "class_name": "RELEVANT"
  "confidence": 0.014

- "classifier_id": "c7fa4ax22-nlc-7007"
  "text": "I am shivering"
  "class_name": "NOTRELEVANT"
  "confidence": 0.007

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Step 3 – Actioning the Alerts

• By leveraging accurate business knowledge and patient information
Level 2 Alerts to Hospitals

Based on a critical number of tweets sent by infected individuals

definitions

set 'RECENT TWEETS' to all tweets, where each tweet is during the last period of 4 hours;

if

there are at least 20 tweets in 'RECENT TWEETS'

then

for each hospital in the hospitals of 'the county'

- emit a new notification to hospital where
  the risk is Flu epidemic,
  the notification level is 2,
  the hospital is this hospital;
Level 2 Alerts to Members

Leveraging the Members’ Patient Record

when an epidemic approaching alert occurs
then
    for each member in the members of 'the county' :
        - emit a new internal member alert where
          the member is this member ,
          the subject is FLU ;

when an internal member alert occurs
if
    the subject of this internal member alert is FLU
    and the vaccinations of 'the member' does not contain
    "flu"
    and the notification option of 'the member' is opt in
then
    emit a new external member alert where
    the language is the preferred language of 'the member' ,
    the member is 'the member' ,
    the subject is FLU ALERT ;
Step 4 – Predicting Where The Epidemic Is Heading
Level 1 Alerts

Based on the Analysis of the Propagation of the Epidemic

when an epidemic localization occurs

definitions
    set COUNTY to a county in the potentially impacted counties of 'the epidemic' ;
if
    the moving geometry of 'the epidemic' is approaching the location of COUNTY
then
    for each hospital in the hospitals of COUNTY : 
        - emit a new notification to hospital where 
          the risk is Flu epidemic ,
        the notification level is 1 ,
        the hospital is this hospital ;
Summary

• Ongoing IBM/KP Collaboration (Trystorms)
  • Drive the adoption and integration of new technologies at KP
  • Offer practical Insight into what is feasible & useful

• Decision Management and IBM ODM
  • DM (and DMN!) is rapidly emerging as a fundamental analysis, modeling and design discipline at KP
  • IBM ODM offers a complex Insight and Diagnostic Capability
  • The KP application design landscape is evolving to draw meaning from unstructured data correlated with structured data
Questions?
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See you at:

Pioneering Decision Services with Decision Modeling at Kaiser Permanente

Speakers: David Herring, James Taylor
Thursday: 3:20 pm - 4:20 pm
Room: Forum 3-5
Additional Slides
Container servers start with 16GB of RAM and scale up from there.